Claims

What is claimed is:

1. A spectrometer comprising:

a transducer having a relative spectral resolution $\underline{\rho_T \geq 0.0001}$ and including:

a dipersive element for dispersing light,

a photodetector for converting light dispersed by the dispersive element into an electrical signal representative of a measured spectrum, and

an analogue-to-digital converter for converting the electrical signal into spectral data $\{\tilde{y}_n$; and,

a processor for enhancing resolution of the spectral data $\{\tilde{y}_n$ to provide spectral data $\{\hat{x}_n\}$ having a relative spectral resolution $\rho_p \leq \rho_T^{\prime}/2$.

2. A spectrometer as defined in claim 1 wherein ρ = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).

3. A spectrometer in claim 2 wherein the transducer comprising a light diffraction grating has a relative spectral resolution $\rho T \in \underline{[0.0001, 0.02]}$ and wherein the spectral data $\{\hat{x}_n\}$ provided by the processor has a relative spectral resolution $\rho_p \leq \rho_T / 5$.

4. A spectrometer as defined in claim 2 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.

5. A spectrometer as defined in claim 2 wherein a single integrated component comprises the transducer.

6. A spectrometer as defined in claim 5 wherein the single integrated component further comprises the processor.

7. A spectrometer as defined in claim 2 wherein the processor comprises calibration means for receiving spectral information relating to a known spectrum $\{x_n^{cal}\}$ and for storing the data relating to the measured spectrum and the known spectrum in memory.

8. A spectrometer as defined in claim 7 wherein the processor comprises calibration means for receiving spectral data $\{y_n^{cal}$ representative of the known spectrum $\{x_n^{cal}\}$,
for choosing a form of an ideal peak $v_s(\lambda,l)$ and of projection operator $\mathcal{G}$ and reconstruction operator R,
for pre-processing the data $\{y_n^{cal}$ for determining parameters $\mathbf{p}_{\mathcal{G}}$ of projection operator $\mathcal{G}$
and parameters $\mathbf{p}_{\mathrm{R}}$ of reconstruction operator R, and
for storing in memory data relating a measured spectrum $x(\lambda)$to its known and substantially idealised spectrum $s(\lambda)$.

9. A spectrometer as defined in claim 8 wherein the processor is customised for use with the transducer.

10. A spectrometer as defined in claim 7 wherein the processor comprises:
means for estimating a vector of positions of peaks $\mathbf{l}$ within a measured spectrum of a sample in dependence upon an estimate $\hat{s}(\lambda)$ of a known idealised spectrum $s(\lambda)$ of a same sample;
means for estimating vector of magnitudes of the peaks $\mathbf{a}$; and,
means for iteratively correcting the estimates of the vector of positions of the peaks and the vector of the estimate of their magnitudes.

11. A miniaturized spectrometric sensor comprising:
a spectrometric transducer having a relative spectral resolution $\underline{\rho_T \geq 0.0001}$ and including:
a port for receiving electromagnetic radiation for measuring a spectrum thereof,

a dispersive element for receiving electromagnetic radiation received at the port and for dispersing the received electromagnetic radiation to provide dispersed electromagnetic radiation, and

a photodetector for receiving the provided dispersed electromagnetic radiation and for converting the dispersed electromagnetic radiation into an electrical signal representative of a measured spectrum of the electromagnetic radiation;

an analogue-to-digital converter for converting the electrical signal into spectral data $\{\tilde{y}_n$ representative of the measured spectrum of the electromagnetic radiation; and,

a processor for receiving the spectral data $\{\tilde{y}_n$, for substantially enhancing the resolution of the spectral data $\{\tilde{y}_n$, and for correcting some errors within those data in dependence upon stored data, the stored data relating the measured spectrum of electromagnetic radiation of a known sample to a known reference spectrum for a same sample.

12. A miniaturised spectrometric sensor comprising:

a spectrometric transducer having a relative spectral resolution $\underline{\rho_T \geq 0.0001}$ and consisting of:

a port for receiving electromagnetic radiation for measuring a spectrum thereof,

a dispersive element for receiving electromagnetic radiation received at the port and for dispersing the received electromagnetic radiation to provide dispersed electromagnetic radiation, and

a photodetector for receiving the provided dispersed electromagnetic radiation and for converting the dispersed electromagnetic radiation into an electrical signal representative of a measured spectrum of the electromagnetic radiation;

an analogue-to-digital converter for converting the electrical signal into spectral data $\{\tilde{y}_n$ representative of the measured spectrum of the electromagnetic radiation; and,

a processor for receiving the spectral data $\{\tilde{y}_n$, for substantially enhancing the resolution of the spectral data $\{\tilde{y}_n$, and for correcting some errors within those data in dependence upon stored data, the stored data relating the measured spectrum of electromagnetic radiation of a known sample to a known reference spectrum for a same sample.

13. A spectrum analyzer comprising:

a transducer having a relative spectral resolution $\underline{\rho_T \geq 0.0001}$ and including:

a dipersive element for dispersing light,

a photodetector for converting light dispersed by the dispersive element into an electrical signal representative of a measured spectrum, and

an analogue-to-digital converter for converting the electrical signal into spectral data $\{\tilde{y}_n$; and,

a processor for enhancing resolution of the spectral data $\{\tilde{y}_n$ to provide spectral data $\{\hat{x}_n\}$ having a relative spectral resolution $\rho_p \leq \rho_T / 2$.

14. A spectrum analyzer as defined in claim 13 wherein ρ = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).

15. A spectrum analyzer in claim 14 wherein the transducer comprising a light diffraction grating has a relative spectral resolution $\underline{\rho T \in [0.0001, 0.02]}$ and wherein the spectral data $\{\hat{x}_n\}$ provided by the processor has a relative spectral resolution $\rho_p \leq \rho_T / 5$.

16. A spectrum analyzer as defined in claim 14 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.

17. A spectrum analyzer as defined in claim 14 wherein a single integrated component comprises the transducer.

18. A spectrum analyzer ~~as~~ defined in claim 17 wherein the single integrated component further comprises the processor.

19. A spectrum analyzer as defined in claim 14 wherein the processor comprises calibration means for receiving spectral information relating to a known spectrum $\{x_n^{cal}\}$

and for storing the data relating to the measured spectrum and the known spectrum in memory.

20. A spectrum analyzer as defined in claim 19 wherein the processor comprises calibration means for receiving spectral data $\{y_n^{cal}$ representative of the known spectrum $\{x_n^{cal}\}$,

for choosing a form of an ideal peak $v_s(\lambda,l)$ and of projection operator G and reconstruction operator R,

for pre-processing the data $\{y_n^{cal}$ for determining parameters $\mathbf{p}_G$ of projection operator G

and parameters $\mathbf{p}_R$ of reconstruction operator R, and

for storing in memory data relating a measured spectrum $x(\lambda)$to its known and substantially idealised spectrum $s(\lambda)$.

21. A spectrum analyzer as defined in claim 20 wherein the processor is customised for use with the transducer.

22. A spectrum analyzer as defined in claim 19 wherein the processor comprises:

means for estimating a vector of positions of peaks $\mathbf{l}$ within a measured spectrum of a sample in dependence upon an estimate $\hat{s}(\lambda)$ of a known idealised spectrum $s(\lambda)$ of a same sample;

means for estimating vector of magnitudes of the peaks $\mathbf{a}$; and,

means for iteratively correcting the estimates of the vector of positions of the peaks and the vector of the estimate of their magnitudes.

23. A spectrometer comprising:

a transducer having a relative spectral resolution $\rho_T \geq 0.001$ and including:

a dipersive element for dispersing light,

a photodetector for converting light dispersed by the dispersive element into an electrical signal representative of a measured spectrum, and

an analogue-to-digital converter for converting the electrical signal into spectral data $\{\tilde{y}_n\}$ and,

a processor for enhancing resolution of the spectral data $\{\tilde{y}_n\}$ to provide spectral data $\{\hat{x}_n\}$ having a relative spectral resolution $\rho_p \le \rho_T / 2$

wherein ρ = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).

24. A spectrometer as defined in claim 23 wherein the dispersive element comprises a light diffraction grating having a relative spectral resolution $\rho_S \in [0.005, 0.015]$ and wherein the spectral data $\{\hat{x}_n\}$ has a relative spectral resolution $\rho_p \le \rho_S / 5$.

25. A spectrometer as defined in claim 23 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.

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